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APPLICATION
FOR
UNITED STATES LETTERS PATENT

TITLE: Medical Keyboard

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MEDICAL KEYBOARD

Related Applications

[0001] This application is related to U.S. patent application serial number
5 60/411,047 (filed 16 September 2002), to which priority is claimed under 35
U.S.C. 120 and which is incorporated herein by reference.

Background

[0002] The invention relates generally to keyboards for computer systems and
more particularly, but not by way of limitation, to keyboards for use in computer
10 systems executing medical software application programs.

[0003] As computer processing capability and user-interface technology has
improved, computer systems have been employed in ever more applications. In
the medical field, for example, physicians now routinely use computers (e.g.,
workstations, personal computers and personal digital assistants) to display and
15 analyze medical data.

[0004] Conventional image-based medical systems include an imaging device
coupled to one or more workstations and one or more server computer systems
through a computer network. In practice, the workstations execute medical
software application programs that permit the user to display, navigate and
20 manipulate medical images generated by the imaging device. Illustrative imaging
devices include Computed Tomography (CT), Magnetic Resonance Imaging
(MRI), ultrasound and X-ray scanners. During evaluation, acquired images are

displayed on the workstation's display and manipulated via input devices such as, for example, a keyboard and/or a pointer device.

[0005] Typical medical software applications (e.g., radiographic and cardiology software applications) include large numbers of functions a physician may use to display, manipulate and evaluate acquired images. These functions typically provide for not only the adjustment and analysis of the images themselves, but also navigation through the images, sorting of images, grouping of images, access to associated patient information and various dictation functions.

10 **[0006]** Referring to FIG. 1, current medical software application programs use standard keyboards such as keyboard **100** for user input. Such keyboards force the user/interpreter to either memorize special functions associated with one or more keys, write down the functions associated with specified keys on strips of paper and place them adjacent to the keys, repeatedly reference a key-code
15 sheet or "hunt-and-peck" until the correct function is performed. It is typical, for example, that function keys **105** (F1 through F15) as well as other key groups (e.g., key groups **110** through **135**) are programmatically assigned functions by the medical software application (either by default or by user action). The large number of functions and keys make it difficult for a physician to effectively use
20 the medical software application. Thus, it would be beneficial to provide a keyboard that simplifies a user's task of using medical software applications.

Summary

[0007] The invention provides a keyboard for use with medical software application programs. Illustrative medical software application programs include those designed for use in the radiology, cardiology, orthopedic and dental fields.

5 In one embodiment, a first visually distinct key group includes keys having icons representative of medical image display functions and a second visually distinct key group includes keys having indications of medical image navigation functions. In one embodiment, keys in the first key group have icons that depict predetermined body regions such that when activated, the displayed image is
10 optimized for viewing that body region represented by the activated key's icon.

[0008] In another embodiment, a third visually distinct key group is provided that includes keys associated with medical image manipulation functions. In yet another embodiment, a fourth visually distinct key group is provided that includes keys associated with patient information retrieval, modification and
15 creation functions.

Brief Description of the Drawings

[0009] Figure 1 shows a prior art keyboard.

[0010] Figure 2 shows, in block diagram format, an radiographic computer
20 system in accordance with one embodiment of the invention.

[0011] Figure 3 shows icons used in one embodiment of the invention for invoking image display functions.

[0012] Figure 4 shows illustrative icons for invoking image manipulation functions in accordance with one embodiment of the invention.

[0013] Figure 5 shows a keyboard in accordance with one embodiment of the invention. Figures 5A through 5D show expanded views of key groups identified
5 in FIG. 5.

[0014] Figure 6 shows a keyboard in accordance with another embodiment of the invention. Figures 6A through 6C show expanded views of key groups identified in FIG. 6.

[0015] Figure 7 shows a keyboard in accordance with yet another
10 embodiment of the invention. Figures 7A through 7D show expanded views of key groups identified in FIG. 7.

Detailed Description

[0016] Computer keyboards to facilitate and simplify a user's interaction with
15 medical software applications are described. The following embodiments of the invention, described in the context of a radiographic imaging computer system and associated application programs, are illustrative only and are not to be considered limiting in any respect. For example, the claimed computer keyboard is equally applicable to other medical fields such as cardiology, ophthalmology
20 and dentistry.

[0017] Referring to FIG. 2, radiographic computer system **200** in accordance with one embodiment of the invention comprises imaging device **205**, one or

more server computer systems (only server **210** is shown) and one or more workstations (only workstation **215** is shown) coupled via computer network **220**. As previously noted, illustrative imaging devices include CT, MRI, ultrasound and X-ray scanning devices. Server **210** may be used for network administrative functions and typically includes one or more long-term storage devices (e.g., storage **225**) such as magnetic disks, magnetic tape units, optical disks and combinations thereof. Network **220** may be a direct communication link between imaging device **205**, server **210** and workstation **215**, a medical facilities intranet or may include the Internet. Workstation **215** is typically a personal computer and includes one or more storage devices (e.g., storage device **230**), display **235**, keyboard **240** and a pointer device such as a track-ball or mouse (not shown).

[0018] A significant aspect of radiographic computer system **200** is the interface through which the user (a radiologist) interacts with the medical software application program – i.e., that application program that executes on server **210** and/or workstation **215** which is used to control image retrieval, display and manipulation.

[0019] Modern medical application programs are complex and, in an attempt to ease a user's burden, map large numbers of functions to specified keys on keyboard **240**. It has been found that assigning functions associated with a specific type of operation (image display, image navigation, image manipulation, patient information, etc.) to independently identified key groups and using

uniform icons and unique display characteristics (e.g., color and/or key shape) within each key group to identify a key's specific function, greatly improves a physician's ability to perform their evaluation and document their medical analysis. This, in turn, can speed a physician's evaluation and reduce the number of documentation and/or reading errors associated with the evaluation.

[0020] In one embodiment, a first key group is assigned functions associated with radiological image display. These keys, having a first color and/or shape to distinguish them from standard keyboard keys and/or other key groups, may include keys for displaying images of a patient's: (1) lungs; (2) abdomen; (3) liver; (4) head; (5) knee; (6) neck; (7) mediastinum; (8) spinal region – T1 and T2 views; (9) a scout image (a low resolution whole-body scan); or (10) an ultrasound image. Icons representing these anatomic regions (or other regions of choice) are affixed to or made part of each key in the first key group. Illustrative icons for each of the above-identified regions are shown in FIG. 3.

[0021] In practice, a physician displays one or more images in a series acquired during a patient study. If the image is of the neck region, the key having the "neck" icon is depressed causing the window and level presets to change to those values previously determined to be optimal when viewing the neck region. Similarly, if the image being viewed is of a patient's knee, the "knee key" is depressed causing the window and level presets to change to those values previously determined to be optimal when viewing the knee region. In general, each key is associated with display preset values (e.g., window and level

values) appropriate to the body region identified on the key's icon (and/or text label).

[0022] A second key group may be assigned functions associated with image navigation functions. These keys may be identified by a second color and/or shape to distinguish them from standard keyboard keys and other key groups and may include keys for navigating through a plurality of acquired patient images. Illustrative image navigation functions include going to the: (1) first image in a group of images; (2) the next image in a group of images; (3) the previous image in a group of images; (4) the last image in a group of images; (5) the next series of images in a study; and (6) a prior series of images in a study. Keys in the image navigation key group may have icons and/or descriptive words to identify their function.

[0023] A third key group may be assigned functions associated with image manipulation. Keys in this group may be identified by a third color and/or shape to distinguish them from standard keyboard keys and other key groups.

Functions typically associated with keys in this group include: (1) the activation of image measurement tools; (2) invocation of image correlation procedures; (3) patient listing operations; (4) identification of "regions of interest" in a displayed image and the presentation of detailed information regarding that region (e.g., tissue density); (5) adjusting the displayed image's level up; (6) adjusting the displayed image's level down; (7) adjusting the displayed image's window down; and (8) adjusting the displayed image's window down up. (One of ordinary skill

in the art will recognize that the window and level adjustment functions alter display characteristics of the image by changing the image's display threshold as measured in Hounsfield units.) It will be recognized by those of ordinary skill in the art that while the precise mechanisms to implement these functions and the range of functions provided are unique to the medical software application
5 program used to display the images, many such application programs provide functionally similar operations. Illustrative icons for representing a set of image manipulation operations are shown in FIG. 4.

[0024] A fourth key group may be assigned functions associated with patient
10 information retrieval and manipulation. Keys in this group may be identified by a fourth color and/or shape to distinguish them from standard keyboard keys and other key groups. Functions typically associated with keys in this group include: (1) retrieving a patient's medical history; (2) dictating a physicians report; (3) show other studies preformed; (4) show reports from prior studies; and (5)
15 paperless fax report.

[0025] Figure 5 shows keyboard **500** in accordance with one embodiment of the invention that is adapted to function with the Centricity™ PACS Workstation Software from GE Medical System. In this particular embodiment, color-coded key groups are provided for image display functions (see key group **505** in FIG.
20 5A), image navigation functions such as image selection and window and level adjustment functions (see key group **510** in FIG. 5B), patient information functions (se key group **515** in FIG. 5C) and user support functions such as

program help and physician dictation functions (see key group **520** in FIG. 5D).

While key groups **505-520** in FIGS. 5A-5D are shown as having only icons or only text to denote their function, any key or key group could use both iconic and textual labels.

5 **[0026]** Figure 6 shows keyboard **600** in accordance with another embodiment of the invention that is adapted to function with the eFilm workstation software application from Merge eFilm of Milwaukee, Wisconsin. In this embodiment, color-coded key groups are provided for image display functions (see key group **605** in FIG. 6A), image navigation functions such as image selection and window
10 and level adjustment functions (see key group **610** in FIG. 6B) and user support functions such as program help (see key group **615** in FIG. 6C). While key groups **605-615** in FIGS. 6A-6C are shown as having only icons or only text to denote their function, any key or key group could use both iconic and textual labels.

15 **[0027]** Figure 7 shows yet another keyboard in accordance with the invention adapted to function with the RadWorks software from GE Medical Systems. In this embodiment, color-coded key groups are provided for image display functions (see key group **705** in FIG. 7A), image navigation functions (see key group **710** in FIG. 7B), image measurement functions such as display Hounsfield
20 units (F9), measure distance (F10), display details on designated Region of Interest (F11) and return to patient list saving changes (F12) (see key group **715** in FIG. 7C) and user support functions such as program help (see key group

720 in FIG. 7D). While key groups **705-720** in FIGS. 7A-7D are shown as having only icons or only text to denote their function, any key or key group could use both iconic and textual labels.

- [0028]** As shown in FIGS. 5 through 7, keys within a key group are typically adjacent. That is, keys in the first key group (e.g., the image display key group) are located in one area of the keyboard while keys in a second key group (e.g., the image manipulation key group) are located in another area of the keyboard. While this is not necessary, it has been found that this arrangement makes it easier and faster for users (new and experienced) to select the desired function.
- [0029]** Various changes in the details of the preferred embodiments described above are possible. For instance, the number, color, shape, location and geometric grouping of key groups (e.g., image display, image navigation, image manipulation, and patient information function groups) of keys as well as the specific icons associated therewith may be changed without falling outside the below claims. In addition, key groups other than those described above could be defined. For example, if a medical software application permits the user to control and acquire images from an imaging device, key functions associated with these operations may be assigned to keys comprising a key group. Further, keys having assigned icons may also include text descriptions (see FIG. 3) or, in the alternative, icons may be entirely replaced with text descriptions (see FIG. 4). Further, a single key group as described herein, could be divided into two or

more key groups with each such sub-group having a different visually distinct characteristic (e.g., color).

[0030] While the invention has been disclosed with respect to a limited number of embodiments, numerous modifications and variations will be appreciated by those skilled in the art. It is intended, therefore, that the following claims cover all such modifications and variations that may fall within the true sprit and scope of the invention.